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Rev. 0

Engineering Evaluation/ Cost Analysis (EE/CA) for Disposition of Mixed Waste from the 183-H Solar Evaporation Basins

United States Department of Energy

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March 2003

United States Department of Energy

P.O. Box 550, Richland, Washington 99352

EXECUTIVE SUMMARY

TRI-PARTIES ISSUE EVALUATION OF DISPOSAL ALTERNATIVES FOR 183-H BASIN WASTES

The U.S. Department of Energy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency (the Tri-Parties) are issuing this document to present the results of an engineering evaluation/cost analysis (EE/CA) addressing the disposal of low-level mixed waste from the 183-H Solar Evaporation Basins (183-H Basins). The waste was generated during the closure of the 183-H Basins, which was performed under the *Resource Conservation and Recovery Act of 1976* (RCRA) as part of the 100 Area cleanup action. The scope of this EE/CA includes approximately 12,235 drums and 48 boxes of 183-H Basin waste that are currently stored at the Hanford Site's Central Waste Complex (CWC). A summary description of the waste streams addressed by the EE/CA and the treatment proposed for each in the recommended alternative is provided in Table ES-1.

The Tri-Parties and their contractors are committed to finding ways to accelerate the cleanup while ensuring protectiveness and full compliance with environmental requirements and processes. Cost reduction is also an important consideration. This EE/CA explores an integrated regulatory approach, which can result in cost reduction and/or cost avoidance, as well as accelerated completion of the 183-H Basin low-level mixed waste disposal that will reduce exposure of people and the environment to continued risks associated with the storage of these wastes.

This EE/CA briefly describes previous cleanup and removal actions at the 183-H Basins. The waste characterization process, timing, and results are presented and discussed. The EE/CA identifies removal action objectives and describes three viable alternatives developed to address the disposal of the waste. Each alternative is compared against the criteria of effectiveness (in protecting human health and the environment), implementability, and cost, and a recommended alternative is presented.

Table ES-1. Description of 183-H Basin Waste Streams Addressed by this EE/CA. (2 Pages)

Waste Stream	Name Used on Designation	Table in Appendix B	Number of Containers	Waste Codes and LDR Treatment Standards (40 CFR 268)	UHCs	Treatment Proposed in Recommended Removal Action
Basin 3 solids[a]	Basin #3 Sludge	B-1	~2,900 Drums	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance
Repackaged solids	183-H Repackaged Sludge Waste	B-1	~75 Drums	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance
Solidified liquid (includes solidified seepage liquids)	183-H Solidified Evaporated Liquid Waste and 183-H Solidified Seepage Liquid Waste	B-2	~2,700 Drums and 13 boxes	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance
Sandblast grit	183-H Basin Sandblast Grit Waste	B-1	~190 Drums	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance
Miscellaneous waste[b]	183-H Basin Debris Waste	B-1	~670 Drums and 18 boxes	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization • Organic/carbonaceous waste – land disposal prohibited unless treatment facilities not available	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance • Organic carbonaceous – No treatment required, treatment facilities not available

Table ES-1. Description of 183-H Basin Waste Streams Addressed by this EE/CA. (2 Pages)

Waste Stream	Name Used on Designation	Table in Appendix B	Number of Containers	Waste Codes and LDR Treatment Standards (40 CFR 268)	UHCs	Treatment Proposed in Recommended Removal Action
Basin 4 solids	183-H Basin #4 Sludge	B-3	~1,300 Drums	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization • D007 - Cr <0.6 mg/L TCLP and meet 40 CFR 268.48 • D009 (low-mercury non-RMERC residual subcategory) - Hg <0.025 mg/L TCLP and meet 40 CFR 268.48 • D011 - Ag <0.14 mg/L TCLP and meet 40 CFR 268.48 • D001 – Deactivation and meet 40 CFR 268.48 standards or recovery of organics or combustion	Pb, Sb, Cd, Th	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance • D007 - Reduction of leachability to LDR standard via cement stabilization • D009 - Reduction of leachability to LDR standard via cement stabilization • D011 - Reduction of leachability to LDR standard via cement stabilization • D001 – Deactivation by chemical reduction • UHCs – Reduction of leachability to UTS via cement stabilization
Precipitated crystal solids	183-H Basin Precipitated Crystal Waste	B-3	~4,400 Drums and 17 boxes	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization • D001 – Deactivation and meet 40 CFR 268.48 standards or recovery of organics or combustion	None	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance • D001 – Deactivation by chemical reduction

[a]Sampling and analysis will be performed to confirm designation or waste will be treated to treat the principal toxicity characteristic constituent and meet 40 CFR 268.48 standards.
[b]Consists of debris such as protective clothing, pallets, and equipment generated during basin cleanup.

CFR = *Code of Federal Regulations*
Cn = cyanide
LDR = land disposal restriction
NA = not applicable
UHC = underlying hazardous constituent
UTS = universal treatment standard

DISPOSAL ALTERNATIVES EVALUATED

The three alternatives developed for disposal of the 183-H Basin waste are as follows:

1. No Action (Continued Long-Term Storage at the CWC). Continued storage at the CWC would result in increased risk to workers and the environment due to the active management of the waste. There would continue to be incremental costs for the continued storage of this waste at the CWC.

2. Treatment/Environmental Restoration Disposal Facility (ERDF) Disposal. This alternative involves treating (chemical reduction and stabilization) the fraction of 183-H Basin waste that exhibits the characteristic of ignitability and then disposing of the treated waste in the ERDF; the balance of the waste would be disposed in the ERDF without treatment. The total cost of container preparation and shipment, treatment, and disposal at the ERDF is approximately $3.7 million.

3. No Treatment/ERDF Disposal. This alternative involves disposing of all of the waste in the ERDF without treatment. The total cost of container preparation and shipment and disposal at the ERDF is approximately $2.1 million. This alternative would not satisfy all the applicable or relevant and appropriate requirements (ARARs) for the waste; therefore, variances would be required to implement this alternative.

RECOMMENDED ALTERNATIVE

The recommended alternative is Treatment/ERDF Disposal. Although this alternative is more costly than the No Treatment/ERDF Disposal alternative, it is the only alternative that is effective at protecting human health and the environment, meets ARARs, and meets the treatment standards for all the applicable waste codes and underlying hazardous constituents (including the alternate treatment standards for formic acid and vanadium, for which treatability variances are requested). Under the recommended alternative, approximately 5,700 drums and 17 boxes of waste would be treated via chemical reduction and cement stabilization and disposed in the ERDF. Another 6,535 drums and 31 boxes of waste that already meet treatment standards would be disposed in the ERDF without treatment. This alternative will comply with ARARs, including RCRA LDRs. However, a variance for some of the LDRs would be authorized under this proposed alternative. RCRA LDRs provide for treatability variances if certain criteria are met. These variances are based on the conclusion that the treatment standards for formic acid and vanadium pentoxide are inappropriate based on the form of the waste and concentration of the constituents.

Based on the assumptions used to evaluate the recommended alternative, the total cost would be approximately $3.7 million and will be implemented over a 36-month period. Actual treatment and disposal time frames would be determined by working with facility resources and schedules.

REGULATORY INTEGRATION

The Tri-Parties have reviewed disposal options for this waste as part of an initiative to find more cost-effective and protective ways to dispose of Hanford Site waste. As a result, they have determined that a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) removal action is appropriate for evaluating disposal pathways for the 183-H Basin waste stored at the CWC.

CERCLA provides clear authority over all hazardous substances (including radionuclides), and the use of CERCLA authority allows consideration of the Hanford Site ERDF as a potential disposal option. The ERDF is a highly engineered facility, constructed and operated under CERCLA authority, that is designed to meet RCRA technological requirements for landfills, including standards for a double liner, a leachate collection system, leak detection, final cap, and groundwater monitoring. CERCLA authority requires that removal action alternatives be evaluated for compliance with the substantive requirements of applicable federal and state laws and regulations (such as RCRA).

CERCLA authority was previously used to determine the disposal pathway of low-level waste (concrete and soil) from the 183-H Basins, which was sent to the ERDF. The 183-H Basins are part of the 100-HR-1 Operable Unit and the 100 Area National Priorities List site. The 183-H Basin waste is designated as a hazardous waste under RCRA and the Washington State *Hazardous Waste Management Act* (Chapter 70.105 *Revised Code of Washington*) through implementing regulations at *Washington Administrative Code* 173-303, and compliance with all substantive provisions of RCRA will be required when addressing the 183-H Basin waste under CERCLA authority.

BACKGROUND OF THE 183-H BASIN FACILITY

Waste Origin

The 183-H Basins included a series of 16 concrete basins located in the 100 Area of the Hanford Site that were originally used to support the 183-H Water Treatment Facility associated with operation of the 100-H Reactor. In 1973, 4 of the 16 basins, which are the subject of the EE/CA, were designated to treat chemical wastes generated during the fabrication of nuclear fuel in the 300 Area. The remaining 12 basins were demolished in 1974. Very small quantities of compatible chemical wastes (e.g., unused inorganic laboratory chemicals) were also discharged into the basins on a nonroutine basis. The basin treatment process consisted of natural solar evaporation to achieve volume reduction. In 1985, the last shipment of process waste was sent to the basins.

Regulatory History

The cleanup of the 183-H Basins demonstrates the regulatory integration of RCRA and CERCLA. Both authorities have been used to designate, transport, and manage the waste associated with this project. Closure of the remaining four 183-H Basins began in 1986 and was completed in 1996. The primary document that enabled the cleanup to proceed was a RCRA closure plan that was approved by the Washington State Department of Ecology and included in the Hanford Facility RCRA Permit (DOE-RL 1991). Completed closure activities consisted of removing chemical wastes, sediment, and debris from the basins; sandblasting and scabbling the basin walls to remove contaminated concrete; demolishing and disposing of the remaining concrete structure and equipment; and removing underlying soil.

Waste generated during the 1987-1991 remedial actions was packaged into drums and boxes in preparation for storage since, at the time these waste streams were generated, the Hanford Site lacked the capacity for treating and disposing of these mixed (i.e., radioactive and hazardous) wastes. These wastes were transferred to the CWC in the 200 Areas of the Hanford Site between 1987 and 1991. Approximately 12,235 drums and 48 boxes of these 183-H Basin mixed waste streams, now stored in the CWC, are the subject of this EE/CA.

Waste generated during the 1996 remedial activities, such as bulk concrete and soil, was designated as low-level waste. Disposal options for these wastes were evaluated using an EE/CA (BHI 1996). The resulting CERCLA Action Memorandum concluded that the ERDF provided the best combination of protection and cost-effectiveness for disposal of the low-level waste (EPA 1996).

DESCRIPTION OF WASTE

The routine waste discharged into the four 183-H Basins consisted of spent acid etch solutions (primarily nitric, sulfuric, hydrofluoric, and chromic acids) generated by the nuclear fuel fabrication process in the 300 Area. These acidic solutions were treated with excess sodium hydroxide to achieve an alkaline pH before being transported to the basins. A total of 9,621,000 L (2,542,000 gal) of neutralized solution were discharged to the 183-H Basins during the period of waste operations (1973 through 1985). Small quantities of unused chemicals, including discarded chemical products listed under RCRA, were also discharged to the basins on a nonroutine basis. The listed hazardous waste discharges consisted of approximately 9 kg (20 lb) of cyanide wastes, 0.9 kg (2 lb) of formic acid, and 0.4 L (0.1 gal) of saturated vanadium pentoxide solution.

A variety of waste forms were generated during the 183-H Basin closure effort, including solids, sludges, precipitated crystals, solidified liquids, sandblasting grit, and miscellaneous waste (secondary waste such as protective clothing, pallets, and equipment). Extensive characterization and waste designation processes were coordinated with the regulators and implemented to support eventual disposal of the waste. These various wastes can be placed into two main categories for purposes of evaluating disposal alternatives:

- Waste that requires treatment for the ignitability characteristic and/or toxicity characteristic principal constituents prior to disposal. Approximately 5,700 containers of waste fall into this category. This waste exhibits the RCRA characteristic of ignitability due to the presence of high levels of sodium nitrate, an oxidizer.

- Waste that does not exhibit the ignitability or the toxicity characteristic and that can be disposed of with no further treatment. Approximately 6,500 containers are grouped into this category.

Both categories of waste are subject to RCRA land disposal treatment standards for formic acid, vanadium pentoxide, and cyanide salts. All waste streams satisfy the RCRA treatment standards for cyanide salts. However, the technology-based treatment standards for the formic acid and vanadium pentoxide are not technically appropriate for the waste medium and constituent concentrations. The U.S. Department of Energy proposes to satisfy the land disposal restriction treatment standards for formic acid and vanadium pentoxide by obtaining waste-specific treatability variances that would use alternate concentration-based treatment standards. The waste streams meet these treatment standards, thereby allowing disposal in the ERDF without treatment other than for the characteristic of ignitability.

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CWC	Central Waste Complex
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
LDR	land disposal restriction
LLW	low-level waste
RCRA	*Resource Conservation and Recovery Act of 1976*
TCLP	Toxicity Characteristic Leaching Procedure
UHC	underlying hazardous constituent
UTS	universal treatment standard
WAC	*Washington Administrative Code*

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

1.0 INTRODUCTION

This document presents the results of an engineering evaluation/cost analysis (EE/CA) that addresses the disposition of mixed (dangerous and radioactive) waste from the 183-H Solar Evaporation Basins (183-H Basins). The waste was generated during the closure of the 183-H Basins, which was performed under the *Resource Conservation and Recovery Act of 1976* (RCRA) as part of the 100 Area cleanup action. The waste is currently stored at the Hanford Site's Central Waste Complex (CWC). Hazardous substances[1] in the waste present a potential threat to human health and the environment, and a non-time-critical removal action[2] is warranted to mitigate the threat.

The 183-H Basin waste cannot remain at the CWC indefinitely. The current baseline for the Mixed Waste Treatment Program identifies approximately $12 million for offsite treatment (assuming no RCRA treatability variances) of the 183-H Basin waste followed by disposal at the Hanford Site Mixed Waste Disposal Unit (see Appendix A for cost details). The U.S. Department of Energy (DOE), together with the Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA) (the Tri-Parties), reviewed disposal options for this waste as part of a broader initiative to find more cost-effective ways to dispose of low-level waste (LLW) and mixed low-level waste. The Tri-Parties have determined that a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) removal action for the 183-H Basin waste is appropriate for several reasons:

- CERCLA provides clear authority over all hazardous substances in the waste, including all hazardous waste constituents as well as radionuclides.
- Use of CERCLA authority also allows consideration of the Hanford Site Environmental Restoration Disposal Facility (ERDF) as a potential disposal option.[3]
- Use of the CERCLA process is consistent with the previous use of the CERCLA process to determine the disposition of LLW from the basins and the fact that the 183-H Basins are part of the 100-HR-1 Operable Unit and the 100 Area National Priorities List site.

[1] "Hazardous substances" means those substances defined by Section 101(14) of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).
[2] "Remove" or "removal," as defined by Section 101(23) of CERCLA, refers to the cleanup or removal of released hazardous substances from the environment; actions if a threat of release of hazardous substances occurs; actions to monitor, assess, and evaluate the release (or threat of release) of hazardous substances; the disposal of removed material; or other actions that may be necessary to prevent, minimize, or mitigate damage to public health or welfare or to the environment, which may otherwise result from a release or threat of release. If a planning period of at least 6 months exists before onsite actions must be initiated, the removal action is considered non-time-critical and an EE/CA is conducted.
[3] Only waste accompanied by a CERCLA decision document is eligible for disposal in the ERDF.

The Tri-Parties will use this EE/CA to evaluate potential removal actions for the waste. Because the waste is designated as a hazardous waste under RCRA and the Washington State *Hazardous Waste Management Act* through implementing regulations at *Washington Administrative Code* (WAC) 173-303, compliance with all substantive requirements imposed by those laws and their associated regulations was evaluated for each alternative, as required by CERCLA.

This EE/CA was prepared in accordance with CERCLA and Title 40, *Code of Federal Regulations* (CFR), Section 300.415. The purpose of the EE/CA is to evaluate viable alternatives and identify a recommended removal action. After the public has commented on the alternatives presented in this EE/CA, the Tri-Parties will evaluate public comments and select an action to disposition the 183-H Basin mixed waste. Their decisions will be documented in an Action Memorandum.

2.0 SITE CHARACTERIZATION

2.1 BACKGROUND

The 183-H Basins were a series of 16 concrete basins located in the 100 Areas of the Hanford Site (Figures 2-1 and 2-2) that were originally used to support the 183-H Water Treatment Facility. In 1973, four of the basins were designated to treat acid etch solutions that were generated during the fabrication of nuclear fuel in the 300 Area. The remaining 12 basins were demolished in 1974. The treatment process consisted of natural solar evaporation to achieve volume reduction. In 1985, the last shipment of waste was sent to the basins. In November 1989, the 100 Areas was one of four Hanford Site areas placed on the EPA's National Priorities List under CERCLA. The 183-H Basins are one of the waste sites contained in the 100-HR-1 Operable Unit, which is undergoing remediation under CERCLA.

The waste materials from the 300 Area include mixed radioactive and dangerous waste. When RCRA regulations were applied to mixed waste at DOE facilities, the 183-H Basins were identified as a treatment, storage, and disposal unit under RCRA. Closure activities generated waste streams that were characterized and designated as mixed waste. The waste was packaged into drums and boxes. At the time these waste streams were generated, the Hanford Site lacked the capacity for treating and disposing of mixed waste. Therefore, the wastes were transferred to the CWC in the 200 Areas of the Hanford Site for interim storage. These 183-H Basin mixed waste streams are the subject of this EE/CA.

2.2 PREVIOUS CLOSURE AND REMOVAL ACTIONS

Closure of the 183-H Basins began in 1986, was completed in 1996, and was performed in accordance with a closure plan that was approved by Ecology and included in the Hanford Facility RCRA Permit (DOE-RL 1991). Closure consisted of removing sediment and debris from the basins, sandblasting and scabbling the basin walls to remove contaminated concrete, demolishing and disposing of the remaining concrete structure and equipment, and removing underlying soil.

Several waste streams generated during closure, such as the bulk concrete and soil, were designated as LLW, and their disposal was evaluated in a previous EE/CA (BHI 1996). The Action Memorandum issued subsequent to that EE/CA concluded that the ERDF provided the best combination of protection and cost-effectiveness for disposal of the LLW (EPA et al. 1996).

2.3 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

The 183-H Basins received both routine and nonroutine wastes. The routine waste consisted of spent acid etch solutions (primarily nitric, sulfuric, hydrofluoric, and chromic acids) generated by the nuclear fuel fabrication process (DOE-RL 1991). These acidic solutions were treated to an alkaline pH with excess sodium hydroxide before being transported to the basins. A total of 9,621,000 L (2,542,000 gal) of solution were discharged to the 183-H Basins during the period of waste operations (DOE-RL 1991). Small quantities of unused chemicals, including discarded chemical products listed as hazardous waste under RCRA, were also discharged to the basins on a nonroutine basis. The approximate amount of each RCRA-listed discarded chemical disposed at the 183-H Basins is provided in Table 2-1.

Table 2-1. Quantity of RCRA-Listed Discarded Chemical Products Discharged to the 183-H Basins (DOE-RL 1991).

Material Description	Year Disposed	Quantity
Unused formic acid	1976	0.9 kg (2 lb)
Unused saturated vanadium pentoxide aqueous solution	1976	0.4 L (0.1 gal)
Unused cyanide solutions	1976	7.6 L (2 gal)
Unused cuprous cyanide	1977	0.45 kg (1 lb)
Unused sodium cyanide	1977	0.45 kg (1 lb)
Unused potassium cyanide	1977	0.23 kg (0.5 lb)

Key information regarding the mixed waste streams addressed in this EE/CA is summarized in Table 2-2.

Table 2-2. Description of 183-H Basin Waste Streams Addressed in this EE/CA.

Waste Stream	Name Used on Designation	Table in Appendix B	Number of Containers
Basin 3 solids	Basin #3 Sludge	B-1	~2,900 Drums
Repackaged solids	183-H Repackaged Sludge Waste	B-1	~75 Drums
Solidified liquid (includes solidified seepage liquids)	183-H Solidified Evaporated Liquid Waste and 183-H Solidified Seepage Liquid Waste	B-2	~2,700 Drums and 13 boxes
Sandblast grit	183-H Basin Sandblast Grit Waste	B-1	~190 Drums
Miscellaneous waste[a]	183-H Basin Debris Waste	B-1	~670 Drums and 18 boxes
Basin 4 solids	183-H Basin #4 Sludge	B-3	~1,300 Drums
Precipitated crystal solids	183-H Basin Precipitated Crystal Waste	B-3	~4,400 Drums and 17 boxes

[a]Secondary waste consisting of debris such as protective clothing, pallets, and equipment generated during waste management.

The total volume of waste included in the scope of this EE/CA is almost 4,000 m^3 (about 12,235 drums and 48 boxes) (FH 2002). The Basin 3 solids, Basin 4 solids, and repackaged solids are sludge from those specific basins. The precipitated crystal formed from Basin 1, 2, 3, and 4 liquids that were aggregated and partially evaporated. Partially evaporated liquid was solidified in 1989 and 1990 (Pierce 1996). This included two subsets of solidified liquids: (1) liquid that was partially evaporated in 1989, identified as solidified evaporated liquids; and (2) liquid that seeped out of the precipitated crystal identified as solidified seepage liquid. Sandblast grit came from the sandblasting of the basin walls. Miscellaneous waste is primarily secondary waste (e.g., protective clothing, pallets, equipment) generated from the various waste handling activities.

2.4 ANALYTICAL DATA

All of the major waste streams (except miscellaneous waste) were analyzed for chemical, radiological, and physical properties as described in *183-H Basin Mixed Waste Analysis and Testing Report* (WHC 1995). Key results are provided in Table 2-3, and more detailed analyses and waste designation information are provided in Appendix B.

Table 2-3. Selected Analytical Results for 183-H Basin Mixed Waste Streams.[a]

Analyte	Basin 3 Solids	Basin 4 Solids	Repackaged Solids	Sandblast Grit	Precipitated Crystal	Solidified Liquid	
						Solidified Evaporated Liquid	Solidified Seepage Liquid
Formate[b] (mg/kg)	366	84.65	40.7	3.3	697	216	177
Total cyanide (mg/kg)	1.61	0.52	1.38	0.27	9.58	1.1	0.33
Amenable cyanide (mg/kg)	1.5 (max)	None detected	NA	None detected	0.26	0.32	0.33
NO_2/NO_3 (mg-N/kg)	27,700	80,900	43,400	89.15	143,500	4,525	4,330
Total organic carbon (mg/kg)	1,330	1,525	631	670	377.5	6,520	7,395
Vanadium (mg/kg)	31.6	1.15	32.3	3.5	0.84	5.9	5.8
Technetium-99 (pCi/g)	800	1,750	760	6.0	135	4,600	3,450
Total uranium (µg/g)	1,200	660	510	9.8	26	320	165

[a]All values are median values unless otherwise indicated.
[b]Formate is the analytical constituent of formic acid that can be measured.
NA = not analyzed

The waste streams addressed in this EE/CA have been designated as low-level mixed waste based on process knowledge and the waste analysis. Per the waste designation (FH 2002), all of the waste streams carry the listed waste codes attached to the original waste stream as a result of the disposal of regulated discarded chemical products. These codes are as follows:

- U123 (formic acid)
- P120 (vanadium pentoxide)
- P030 (cyanide salts)
- P029 (copper cyanide)
- P106 (sodium cyanide)
- P098 (potassium cyanide).

For all wastes except Basin 4 solids, all toxicity characteristic organic and metal constituents in the analyzed waste streams were below toxicity characteristic designation limits. The toxicity characteristic waste designations for the Basin 3 solids were based on analyses performed using the EP Toxicity test, which was the method in use at the time of analysis. Since that time, the analytical method for characteristic waste designation has been revised to the Toxicity Characteristic Leaching Procedure (TCLP). Using the total metals analyses for the Basin 3 solids and assuming that 100% of the metals leach from the waste, the solids would designate for additional waste codes (D007, D011, and D009 [low-mercury non-RMERC residual subcategory]). However, the assumption of 100% leachability is conservative and is not observed for the repackaged solids, which are a combination of Basin 3 and 4 solids and which were analyzed using the TCLP. This issue is not relevant for two of the removal action alternatives (i.e., no action and no treatment/ERDF disposal) because they would not include treatment regardless of waste designation. If the second alternative (treatment/ERDF disposal) were to be selected, the waste would either be reanalyzed prior to disposal using the TCLP method to document the absence of the D007, D009 (low-mercury non-RMERC residual subcategory), and D011 waste codes or would be treated prior to disposal in a manner that removes the D007, D011, and D009 (low-mercury non-RMERC residual subcategory) waste codes and treats to any applicable universal treatment standards. The same logic also applies to the Basin 4 solids waste stream. However, because the D001 waste code is applicable, heavy metals meet the definition of underlying hazardous constituents (UHCs) and must be treated. Since the waste stream must be treated for these metals as UHCs regardless of the designation status, the D007, D009 (low-mercury non-RMERC residual subcategory), and D011 waste codes will be applied rather than performing sampling to determine if they need to be applied. An extensive list of organic analytes was used as the basis for analysis, and no organics were detected at levels of concern (designation or universal treatment standard [UTS] levels).

The Basin 4 solids and precipitated crystal waste streams have been assigned the ignitable characteristic waste code D001 due to the presence of significant quantities of sodium nitrate in the waste. Surrogate material containing sodium nitrate at concentrations similar to those found in the Basin 4 solids and precipitated crystal waste was tested using the U.S. Department of Transportation (DOT) oxidizer test. Based on the results of the test, the waste meets the DOT definition of an oxidizer, which is one criterion used to define the characteristic of ignitability (WAC 173-303-090[5][a][iv]).

The miscellaneous waste was not sampled or analyzed. However, the waste is potentially contaminated as a result of contact with the primary waste streams such as basin sludge. Designation was performed using process knowledge. All of the listed waste codes have been applied to the miscellaneous waste. Some of the waste has been designated as organic/ carbonaceous waste (i.e., dangerous waste containing greater than 10% organic or carbonaceous constituents) because of the presence of material such as wood pallets. To determine the characteristic waste designation status of the waste, it was assumed that 10% of the total mass of the waste is contaminated at concentrations equal to the contaminant concentrations in the worst-case primary waste streams. For example, if a wood pallet were to weigh 45 kg (100 lb), it was assumed that 4.5 kg (10 lb) of that total was, in effect, primary waste such as precipitated crystal waste at its worst-case concentration. The contaminant mass in that 10% was then averaged over the total mass of the pallet, and the resulting contaminant concentrations were compared to the characteristic waste designation criteria to determine if the waste would designate as a characteristic waste. In no case did the miscellaneous waste designate as a characteristic waste. This is an industry standard practice to address difficult-to-sample, debris-type waste streams.

Although many of the drums containing the 183-H Basin waste have corroded during the extended storage period, none of the waste streams exhibit the characteristic of corrosivity as defined in WAC 173-303-090(6)(i) and (ii). The waste is not a liquid, and in any case the measured corrosion rate is less than 0.25 in. steel/year. The pH of some of the solid waste streams is greater than 12.5, which defines a state-only corrosive waste. Washington State regulations for the designation of waste state that once a federal-listed waste code is applied, no further waste codes need to applied unless the application would change the management of that waste (e.g., change the land disposal restriction [LDR] standards). Because there are no specific LDR treatment standards for state-only basic solid waste, nor any other specific management standards, application of the state-only waste code would not be appropriate.

The waste codes assigned to each waste stream are provided in Table 2-4, and additional waste designation information is included in Appendix B.

2.5 RISK EVALUATION

The waste addressed in this EE/CA is contaminated with radioactive and nonradioactive hazardous substances. The waste is currently stored in containers that are protected inside CWC buildings, but this does not eliminate the potential risks posed to workers and the environment by the hazardous substances, and these risks will increase over time.

Even in storage, continued waste management is required, including weekly physical inspections to ensure container integrity and legible labeling. More significantly, when inspections reveal breached containers or questionable container integrity, the affected containers must be overpacked to mitigate further breaching and to prevent potential personnel or environmental exposures. Overpacking is labor intensive and involves placing waste containers into larger containers (overpack containers), adding absorbent material, placing a lid on the overpack container, applying new labels, and placing the overpack container on a pallet.

Table 2-4. Waste Designation Summary for 183-H Basin Waste Included in this EE/CA.

Waste Stream[a]	Waste Code	UHCs
Basin 3 solids[b]	U123, P120, P030, P029, P106, P098	NA
Basin 4 solids	D001, U123, P120, P030, P029, P106, P098, D007, D009, D011	Sb, Pb, Th, Cd
Repackaged solids	U123, P120, P030, P029, P106, P098	NA
Sandblast grit	U123, P120, P030, P029, P106, P098	NA
Precipitated crystal	D001, U123, P120, P030, P029, P106, P098	None
Solidified liquid	U123, P120, P030, P029, P106, P098	NA
Miscellaneous waste	U123, P120, P030, P029, P106, P098; organic/carbonaceous waste	NA

[a]For these waste streams, not all the codes listed apply to every container.
[b]D007, D009, and D011 waste codes and potential UHCs may be added based on future sampling.

D001 = ignitability
P029 = copper cyanide
P030 = cyanide salts
P098 = potassium cyanide
P106 = sodium cyanide
P120 = vanadium pentoxide
U123 = formic acid
NA = not applicable

Both the inspection and overpacking activities expose personnel to the hazards associated with the waste, and the large number of containers involved results in a substantial cumulative risk to workers. The dose incurred by workers at the CWC as a result of managing the 183-H Basin waste is estimated at 2,100 mrem/yr, and increases as the need for overpacking increases. In addition, radionuclides are known carcinogens and the nonradioactive contaminants present the potential for both carcinogenic and acute toxicity risks. In the event of a container breach, workers could be exposed directly to these contaminants through skin contact, ingestion, or inhalation. Industrial hazards are associated with the operation of equipment used in overpacking (hoist, forklift, banding machines). In addition, the waste streams that exhibit elevated sodium nitrate concentrations present a physical risk due to their oxidizing nature that could accelerate the combustion of organic matter.

A potential threat to the environment exists because the drums are continuing to deteriorate during storage. Although breached drums can be overpacked, overpacks will not maintain containment indefinitely, and there is a potential for a release to the environment.

Figure 2-1. Map of the Hanford Site.

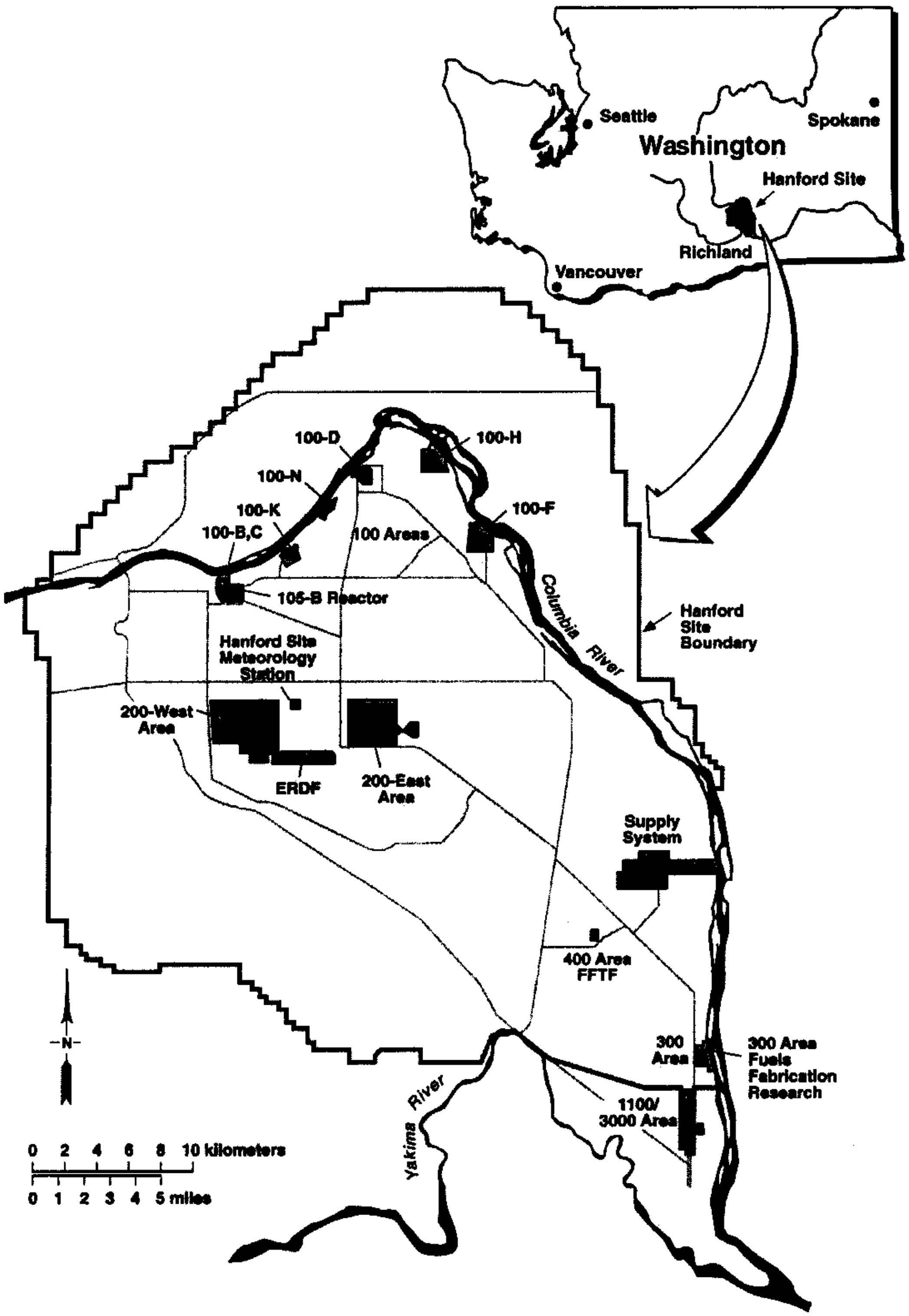
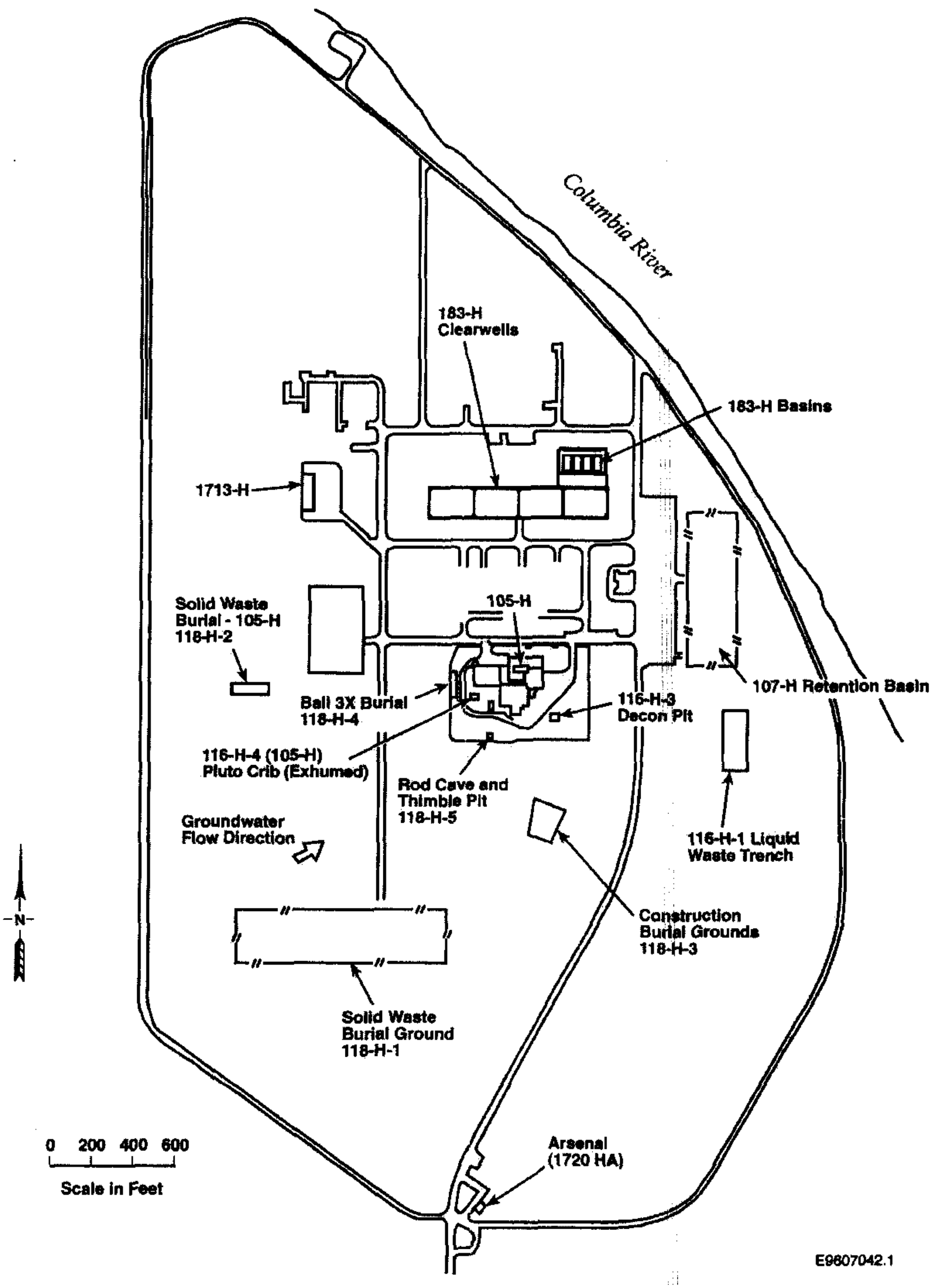


Figure 2-2. Map of the 100-H Area Showing the Former Location of the 183-H Solar Evaporation Basins.



3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

Based on the potential hazards identified in Section 2.5, the specific removal action objectives are as follows:

- Reduce or eliminate the potential for exposure to hazardous substances above levels that are protective of the workers, public, and environment
- Reduce or eliminate the potential for a future release of contaminants
- Protect workers from the physical hazards posed by management of the waste.

4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

Alternatives under consideration for the disposal of the mixed wastes generated by the 183-H Basins closure and currently stored at the CWC are as follows:

- No Action (continued long-term storage at the CWC)
- Treatment/ERDF Disposal
- No Treatment/ERDF Disposal.

4.1 NO ACTION (CONTINUED STORAGE)

For purposes of this EE/CA, the No Action alternative would consist of continued storage of the 183-H Basin waste at the CWC for an indefinite period of time. The waste containers would be inspected on a routine basis, and maintenance (e.g., repackaging leaking containers) would be performed as needed. Although these inspection and maintenance activities are more involved than the typical "no action" alternative under CERCLA, they would be necessary to maintain compliance with RCRA requirements.

4.2 TREATMENT/ERDF DISPOSAL

The Treatment/ERDF Disposal alternative would consist of preparing the 183-H Basin waste containers for shipment at the CWC, transporting the containers to the ERDF, treating a portion of the waste at the ERDF, and disposing of the waste to the ERDF cells. The treatment proposed for each waste stream is summarized in Table 4-1.

4.2.1 Preparation for Shipment

To prepare the 183-H Basin waste for transport, the waste containers (drums, overpacked drums, and boxes) would be removed from their current storage location and taken to an area where the container integrity would be checked and smears would be collected to confirm compliance with radioactive surface contamination limits. The containers would then be relabeled and marked as necessary and loaded onto pallets in preparation for transport.

4.2.2 Transport of Waste from the CWC to ERDF

The 183-H Basin waste containers would be transported from the CWC to the ERDF using trucks/flatbed trailers or, for waste that would be direct disposed, ERDF roll-off containers. Waste management personnel at the CWC would ensure that the waste is packaged and the transport vehicle is placarded for shipment in compliance with applicable DOT and DOE requirements.

Table 4-1. Treatment Proposed by Waste Stream Under the Treatment/Disposal Alternative.

Waste Stream	Number of Containers	Treatment Proposed in Recommended Removal Action
Basin 3 solids	~2,900 Drums	No treatment, assuming confirmation of designation by TCLP
Repackaged solids	~75 Drums	No treatment
Solidified liquid (includes solidified seepage liquids)	~2,700 Drums and 13 boxes	No treatment
Sandblast grit	~190 Drums	No treatment
Miscellaneous waste[a]	~670 Drums and 18 boxes	No treatment
Basin 4 solids	~1,300 Drums	Cement stabilization and deactivation by chemical reduction
Precipitated crystal solids	~4,400 Drums and 17 boxes	Deactivation by chemical reduction

[a]Secondary waste consisting of debris such as protective clothing, pallets, and equipment generated during waste management.

4.2.3 Disposal of Waste Not Requiring Treatment

Approximately 6,535 drums and 31 boxes of 183-H Basin waste (consisting of the Basin 3 solids, repackaged solids, sandblast grit, solidified liquid, and miscellaneous waste)[1] already meet LDR treatment standards[2] and ERDF WAC requirements. These containers would be direct disposed in ERDF without treatment, other than in the event that free liquids are encountered. The method for identifying and resolving free liquid issues would be specified in the removal action treatment plan, which would require approval by the appropriate regulatory agency(s). For direct-disposed waste transported via trucks/trailers, drums and boxes would be offloaded using standard construction equipment (e.g., forklift with sling or drum grappler). If roll-off containers were to be used, drums and boxes would be loaded directly into the roll-off containers (without dumping or removal of contents), and normal container offloading processes would be followed. The offloaded drums and boxes would be placed in the disposal cell and compacted.

The total weight of waste disposed by this process would be approximately 2,400 metric tons (2,600 US tons) (assuming 363 kg [800 lb] of waste per drum). It is assumed that 200 drums of this waste would be transported to the ERDF for disposal each week. At this rate, approximately 33 weeks of continuous operation would be required to dispose of the waste that does not require

[1] Including the Basin 3 solids in the "no treatment" element of this alternative assumes that the waste streams are analyzed using the TCLP protocol and confirmed not to contain toxic metals in excess of the characteristic waste designation criteria. If the waste was to designate as characteristic waste, treatment would be required. The Basin 3 solids would be treated as described in Section 4.2.4.

[2] Satisfaction of LDR treatment standards assumes regulator approval of specific treatability variances for formic acid and vanadium pentoxide.

treatment. However, actual disposal time frames would be determined upon selection of an alternative.

4.2.4 Treatment and Disposal of Waste Requiring Treatment

Approximately 5,700 drums and 17 boxes of 183-H Basin waste (consisting of the Basin 4 solids and precipitated crystal waste) require treatment to eliminate the characteristic of ignitability, toxicity for heavy metals and meet standards for UHCs before disposal in the ERDF (note that the precipitated crystal only needs treatment for the ignitability characteristic). They may also require stabilization in the event that free liquids are encountered. Details of the treatment process, including methods for identifying and resolving free liquid issues, determination of obtaining the required treatment level, bench-scale testing, and post-treatment sampling methodology, would be specified in a removal action treatment plan written to comply with the substantive requirements of WAC 173-303-140, which would require approval by the appropriate regulatory agency(s).

For waste that requires treatment, the loaded trailer would be staged in an appropriately posted and managed area. ERDF personnel would offload the drums and boxes using standard construction equipment (e.g., forklift with sling or drum grappler).

For conservatism in the cost estimate, it is assumed that all drums would be delivered to the ERDF in overpack containers. (It is anticipated that about two-thirds of the drums would actually be overpacked.) In the treatment area, ERDF personnel would remove the overpack lids and lift the drum out of the overpack container using standard construction equipment fitted for drum handling. Empty overpack containers that cannot be salvaged, pallets, and absorbent used as packaging in the overpacks would be put directly into the ERDF disposal cell, compacted, and buried.

The bulk waste would be treated (stabilized) in a fabricated steel mixing box that has been recessed into the ground. The waste would be treated using a sufficient quantity of reducing agent and Portland cement to achieve the treatment objectives. The EPA and DOE have both published studies (EPA 402-R-96-014, *Stabilization/Solidification Processes for Mixed Waste* [EPA 1996] and DOE/EM-0500, *Stabilization of High Salt Waste Using a Cementitious Process* [DOE 1999]) that identify this as a successful treatment technology for similar waste. Treatment agents (both cement and chemical reduction agents) would be purchased, transported, and staged near the treatment location. The waste would be removed from its containers, mixed with the treatment agents inside a recessed mixing box in accordance with an EPA-approved treatment plan, removed from the mixing box, and place in the ERDF cell.

The total number drums treated would be about 5,700 (including 17 boxes assumed to be equal in weight to drums for estimating purposes) and the total weight would be approximately 2,100 metric tons (2,300 US tons) (assuming 363 kg [800 lb] of waste per drum). It is assumed that 200 drums of this waste would be delivered to the ERDF for treatment each week. At this rate, approximately 30 weeks of continuous operation would be required to complete treatment. However, the actual schedule would depend on other waste treatment activities ongoing at the ERDF.

4.3 NO TREATMENT/ERDF DISPOSAL

The No Treatment/ERDF Disposal alternative would consist of preparing the 183-H Basin waste containers at the CWC, transporting the containers to the ERDF, and placing the waste in the ERDF cells. The waste would be prepared and transported as described in Sections 4.2.1 and 4.2.2. At the ERDF, the containers would be offloaded, placed directly into the ERDF cell, compacted, and buried as described in Section 4.2.3.

The total weight of waste disposed by this process would be approximately 4,500 metric tons (4,900 US tons) (assuming 363 kg [800 lb] of waste per drum). It is assumed that 200 drums of this waste would be transported to the ERDF for disposal each week. At this rate, approximately 62 weeks of continuous operation would be required to dispose of the waste. However, actual disposal time frames would be determined upon selection of an alternative.

5.0 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

CERCLA requires removal action alternatives to be evaluated against three criteria: effectiveness, implementability, and cost. The criterion of effectiveness evaluates whether an alternative adequately protects human health and the environment. It also considers whether an alternative complies with applicable or relevant and appropriate requirements (ARARs). The ARARs for this response action are described in Section 5.1. The implementability criterion evaluates whether the alternatives are technically and administratively feasible. The cost criterion evaluates the overall cost of each alternative.

5.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The ARARs must be met for onsite CERCLA actions (CERCLA, Section 121[d][2]). They comprise promulgated laws and regulations pertinent to the removal action under consideration. Onsite actions are exempted from obtaining federal, state, and local permits (CERCLA, Section 121[e][1]), although they must still generally comply with substantive requirements. Nonpromulgated standards, such as proposed regulations and regulatory guidance, are also to be considered to the extent necessary for the removal action to be adequately protective. Removal actions must meet ARARs to the extent practicable considering the exigencies of the situation including appropriate factors such as the urgency of the situation and the scope of the removal action or waived per CERCLA requirements.

Key ARARs for the alternatives being considered are waste management standards and, in the case of the Treatment/ERDF Disposal alternative, standards controlling airborne releases.

5.1.1 Waste Management Standards

RCRA Subtitle C, implemented via 40 CFR 260 through 268, governs the identification, treatment, storage, transportation, and disposal of hazardous waste. Authority for much of Subtitle C has been delegated to the State of Washington. Implementing state regulations contained in WAC 173-303 would be applicable to the mixed waste addressed by this removal action. The regulations require identifying and appropriately managing the dangerous components of mixed wastes and identifying standards for treatment and disposal of these wastes. The LDRs established under RCRA (WAC 173-303-140) prohibit disposal of restricted wastes unless specific concentration- or technology-based treatment standards have been met or a treatability variance is obtained. The LDRs would be applicable to the treatment and disposal of the 183-H Basin mixed wastes. The LDR treatment standards for the 183-H Basin waste codes are shown in Table 5-1.

Table 5-1. Treatment Standards for 183-H Basin Waste Codes.

Characteristic/Chemical	Waste Code	Treatment Standard
Ignitability	D001	Deactivation and meet 40 CFR 268.48 standards or recovery of organics or combustion
Formic acid	U123	Combustion
Vanadium pentoxide	P120	Stabilization
Cyanide (Cn) (various salts)	P029, P030, P098, P106	Total Cn <590 mg/kg Amenable Cn <30 mg/kg
Toxicity characteristic	D007, D009, D011	D007 0.6 mg/L TCLP D009 0.025 mg/L TCLP D011 0.14 mg/L TCLP All three require meeting the 40 CFR 268.48 standards
Organic/carbonaceous waste	NA	Land disposal prohibited unless recycling, chemical/physical treatment, and incineration facilities are not available

NA = not applicable

In addition to the ARARs previously specified, alternatives that propose disposal of waste at the ERDF must meet the ERDF waste acceptance criteria (BHI 2002) and the ERDF leachate delisting petition and approval (DOE-RL 1999, EPA 1999). The ERDF waste acceptance criteria prohibit disposal of free liquids, and define radiological, chemical, and physical characteristics for waste proposed for disposal placement and compaction requirements. The ERDF delisting petition does not limit ERDF to receiving specific waste codes, but does identify the contaminants that ERDF might be expected to receive and specify those that must be analyzed in the leachate.

5.1.2 Standards Controlling Releases to the Environment

The federal and state *Clean Air Acts* regulate both toxic and radioactive airborne emissions. Under implementing regulations found in 40 CFR 61, Subpart H, and WAC 246-247, radionuclide airborne emissions from all combined operations at the Hanford Site may not exceed 10 mrem/yr effective dose equivalent to the hypothetical offsite maximally exposed individual. WAC 246-247 requires verification of compliance, typically through periodic confirmatory air sampling. WAC 173-400 establishes requirements for the control and/or prevention of the emission of air contaminants. The emission standards would apply to any emissions generated during handling or treatment of the 183-H Basin waste.

5.2 EFFECTIVENESS

5.2.1 No Action

This alternative would not be effective at protecting human health and the environment.

5.2.1.1 Long-Term Protectiveness. This alternative would not be protective in the long term. The waste currently is stored at the CWC in compliance with dangerous waste regulations. Continued storage at the CWC would result in ongoing risk to workers and the environment due to the active management of the waste. Ultimately, the waste would require disposition.

5.2.1.2 Short-Term Protectiveness. This alternative would be protective in the short term. Controls at the CWC ensure that worker exposure to the waste is minimized and that the waste containers are maintained in a condition that prevents releases to the environment.

5.2.1.3 Compliance with ARARs. This alternative would comply with ARARs related to storage of mixed waste. However, continued long-term storage may not be compliant with the LDR restriction against storage in lieu of disposal.

5.2.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. This alternative would not involve any treatment.

5.2.2 Treatment/ERDF Disposal

This alternative would be very effective at protecting human health and the environment and would meet all ARARs.

5.2.2.1 Long-Term Protectiveness. This alternative would be protective in the long term. The waste streams that exhibit the characteristic of ignitability (consisting of Basin 4 solids and precipitated crystals) would be treated such that they no longer exhibited that characteristic. Metals that constitute UHCs would be stabilized via the treatment process such that the potential for contaminant migration would be greatly reduced in accordance with UHC standards. Contaminants of concern in the other waste streams are well below levels considered to be a threat to human health or the environment. The waste would be disposed in an engineered landfill that meets the substantive requirements for a RCRA landfill, with a double liner, leachate collection system, and eventual cap.

5.2.2.2 Short-Term Protectiveness. This alternative would be protective in the short term. There would be some risk to workers and the environment during the transportation and treatment activities. Of particular concern would be the need to open about 5,700 drums and 17 boxes of waste. However, concerns regarding worker safety would be mitigated by the use of appropriate drum handling equipment and the backhoe/mix box technique. Waste would be transported and treated using appropriate health and safety plans and/or procedures. Personnel performing the work would be outfitted in the personal protective equipment required by plans and procedures for daily operations (e.g., hard hat, safety glasses, substantial footwear). Water would be used for dust control during all aspects of ERDF operations.

5.2.2.3 Compliance with ARARs. This alternative would meet all ARARs, which would include meeting the alternate treatment standards proposed as part of the LDR treatability variances requested for formic acid and vanadium pentoxide.

LDR Standards. The 183-H Basin waste streams must meet LDR requirements prior to disposal in the ERDF.

Chemical reduction and cement stabilization of the waste streams that exceed 35% sodium nitrate would eliminate the characteristic of ignitability and reduce the leachability of metals that occur as UHCs, thus meeting the LDR treatment standard for D001 waste.

Based on the concentrations of total cyanide and amenable cyanide, all of the waste streams appear to meet the concentration-specific LDR treatment standards for those constituents (590 mg/kg and 30 mg/kg, respectively). Specific analytical data on amenable cyanide are not available for some waste streams. However, amenable cyanide is a fraction of the total cyanide. Thus, the concentration of amenable cyanide cannot exceed the concentration of total cyanide. Given this, if the total cyanide concentration is less than 30 mg/kg, which is true for all of the waste streams, this demonstrates that the standard for amenable cyanide has been met. The total cyanide analyses were obtained using SW-846 Method 9012 and a sample size of 5 g and a distillation time of 60 minutes, which was the EPA-approved method at the time the analyses were performed. Subsequent to those analyses, EPA modified 40 CFR 268.40 to require SW-846, Test Methods 9010 and 9012, along with a sample size of 10 g and a distillation time of 75 minutes. Although the analyses for the 183-H Basin samples used the older methodology, the solids detection limit of 0.5 mg/kg and aqueous detection limit of 10 µg/L for total and amenable cyanide obtained using that methodology are well below the LDR limits. No additional analyses are planned to confirm that the 183-H Basin waste streams meet the LDR standard for cyanide.

For all of the waste streams, DOE proposes to satisfy the LDR treatment standards for formic acid (U123) and vanadium pentoxide (P120) by obtaining waste-specific RCRA treatability variances pursuant to 40 CFR 268.44. Under this proposal, DOE would establish alternate concentration-based treatment standards in lieu of the technology-based treatment standards. Approval of the treatability variances for the 183-H Basin waste would be obtained via the Action Memorandum.

The LDR regulations specify a technology-based treatment standard (combustion) for formic acid. Per 40 CFR 268.44(2), a generator may seek a variance from an applicable treatment standard if *"(i)t is inappropriate to require the waste to be treated to the level specified in the treatment standard or by the method specified as the treatment standard, even though such treatment is technically possible."* To show that this is the case, the generator must either demonstrate that treatment to the specified level or by the specified method is technically inappropriate (e.g., resulting in combustion of large amounts of mildly contaminated environmental media where the treatment standard is not based on combustion of such media), or, for remediation waste only, that treatment is environmentally inappropriate. DOE believes that treatment of the formic acid via combustion would be technically inappropriate. The specified technology of combustion generally assumes a waste consisting primarily of organic matter and would be technically appropriate for formic acid as a pure or concentrated product or in an organic-dominant matrix. The medium addressed in this EE/CA is a inorganic radioactive material with small quantities of organic contamination. Implementation of the required treatment methodology would result in the incineration of large quantities of solids contaminated with radioactivity and heavy metals that contain very low levels of the constituent of concern (the maximum formic acid level is 1,900 mg/kg). EPA has recognized these concerns in two guidance memorandums that support the general position that combustion of a solid waste with little organic contamination would be technically inappropriate (and potentially unallowable).[1,2] As an alternative, DOE proposes to use a concentration-based treatment standard of 160,000 mg/kg, which is equal to the *Model Toxics Control Act Cleanup* direct contact pathway cleanup standard for formate in residential soils (Ecology 2001). This provides a risk-based value that has been established through a formal regulatory process and that is obtainable and appropriate for the waste form.

The LDR regulations also specify a technology-based treatment standard (stabilization) for vanadium pentoxide. DOE believes that treatment of the vanadium pentoxide via stabilization would be technically inappropriate. Stabilization is designed to protect the environment (and exposure pathways to humans) from the leaching of a constituent of concern in a disposal scenario. The treatment standard for P120 waste is designed for waste containing significant quantities of vanadium pentoxide where measurable protection would be provided by reducing leachability. It was not intended for waste where vanadium is a trace contaminant. The concentration of vanadium pentoxide in the 183-H Basin waste is a maximum of 32.3 mg/kg. The background level of vanadium in Hanford Site soils is 85.1 mg/kg at the true upper 90^{th} percentile (DOE-RL 2001). Stabilization would result in the large-scale treatment of a material that already meets the performance standard of the method (i.e., the waste will already leach vanadium at levels less than those already present in the environment), and thus an alternate concentration-based standard would be more appropriate. As an alternative, DOE proposes to use a concentration-based treatment standard equal to the background level of vanadium in Hanford Site soils at the true upper 90^{th} percentile, which is 85.1 mg/kg.

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[1] EPA's guidance memorandum titled "Use of Site-Specific Land Disposal Restriction Treatability Variances Under 40 CFR 268.44(h) During Cleanups" makes the following points.

> "**Cleanup of contaminated soils where the generally applicable land disposal treatment standards are based on combustion.** For large quantities of contaminated soils with relatively low concentrations of hazardous constituents, EPA generally considers treatment standards based on combustion inappropriate.
>
> **Cleanup of old sludges initially placed prior to the effective date of land disposal prohibitions.** In some cases the physical or chemical composition of sludges become significantly altered upon prolonged exposure to: natural sunlight, acidic rainfall, weather cycles (such as freeze-thaw) and intrusion, commingling, or chemical reaction with rainfall, soil, windblown dirt and/or other co-disposed wastes. These types of exposure can result in changes in composition through: evaporation or migration of volatiles, sunlight induced polymerization of organics, lime stabilization (i.e., self-cementation), photo-degradation, natural biodegradation, hydrolysis, and even electrolytic oxidation/reduction reactions. As a result, weathered sludges often no longer have the physical or chemical composition of newly generated sludges and a treatability variance may be warranted." (EPA 1997)

[2] EPA's guidance memorandum titled "RCRA Policy Statement: Clarification of the Land Disposal Restrictions' Dilution Prohibition and Combustion of Inorganic Metal-Bearing Hazardous Wastes" states "that a prohibited inorganic metal containing hazardous waste...without significant organic content can be considered to be diluted impermissibly when combusted (even if the treatment standards for metals are achieved in part by subsequent treatment of combustion ash)." (EPA 1994)

The organic/carbonaceous designation attached to the miscellaneous waste does not invoke treatment requirements. The DOE has previously submitted and obtained approval from Ecology for a certification of the nonavailability of adequate treatment facilities for such waste. In light of this certification, organic/carbonaceous waste that otherwise meets LDR disposal requirements can be disposed in the ERDF.

The empty drums generated when the ignitable waste is removed for treatment can be disposed at the ERDF without further treatment, assuming that the formic acid and vanadium pentoxide treatability variance approach is authorized. Following waste removal, the drums would be empty (per the RCRA definition) and would no longer carry the D001 designation.

The 183-H Basin waste streams, associated waste codes, LDR treatment standards, and proposed method of complying with these standards in the Treatment/ERDF Disposal alternative are summarized in Table 5-2. Specific requirements for meeting the LDR treatment standards would be defined in a regulator-approved removal action treatment plan.

Table 5-2. Treatment/ERDF Disposal Alternative: Meeting LDR Treatment Standards. (2 Pages)

Waste Stream	Waste Codes and LDR Treatment Standards (40 CFR 268)	UHCs	LDR Compliance Approach Proposed in Treatment/ERDF Disposal Alternative
Basin 3 solids[a]	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance
Repackaged solids	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance
Solidified liquid (includes solidified seepage liquids)	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance
Sandblast grit	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance

Table 5-2. Treatment/ERDF Disposal Alternative: Meeting LDR Treatment Standards. (2 Pages)

Waste Stream	Waste Codes and LDR Treatment Standards (40 CFR 268)	UHCs	LDR Compliance Approach Proposed in Treatment/ERDF Disposal Alternative
Miscellaneous waste[b]	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization • Organic/carbonaceous waste – Land disposal prohibited unless treatment facilities not available	NA	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance • Organic/carbonaceous – No treatment required; facilities not available
Basin 4 solids	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization • D001 – Deactivation and meet 40 CFR 268.48 standards (UTS) or recovery of organics or combustion • D007 - Cr <0.6 mg/L TCLP and meet 40 CFR 268.48 • D009 (low-mercury non-RMERC residual subcategory) - Hg <0.025 mg/L TCLP and meet 40 CFR 268.48 • D011 - Ag <0.14 mg/L TCLP and meet 40 CFR 268.48	Sb, Pb, Th, Cd	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance • D001 – Deactivation by chemical reduction • D007, D009, D011 - Reduction of leachability to LDR standard via cement stabilization • UHCs – Reduction of leachability to UTS via cement stabilization
Precipitated crystal solids	• U123 – Combustion • P029, 030, 098, 106: Total Cn <590 mg/kg, amenable Cn <30 mg/kg • P120 – Stabilization • D001 – Deactivation and meet 40 CFR 268.48 standards or recovery of organics or combustion	None	• U123 – Treatability variance • P029, 030, 098, 106 – Standards already met in waste • P120 – Treatability variance • D001 – Deactivation by chemical reduction

[a]Sampling and analysis will be performed to confirm designation or treatment performed.
[b]Secondary waste consisting of debris such as protective clothing, pallets, and equipment generated during waste management.
Cn = cyanide
NA = not applicable
UTS = universal treatment standard

Air Emissions Standards. The handling and treatment system for the 183-H Basin waste would be designed to ensure that air emissions are controlled as required to meet emission standards in 40 CFR 61, Subpart H, WAC 246-247, and WAC 173-400. The only emissions that would be expected from the stabilization process would be fugitive dust. A water spray would be used as necessary to control dust. If it is determined that there is a potential for nonzero radioactive emissions, best available radionuclide control technology would be applied.

Disposal Requirements. This alternative would meet the substantive requirements of the ERDF waste acceptance criteria and the ERDF leachate delisting approval. For purposes of this removal action, the 183-H Basins, the CWC, and the ERDF may be treated as a single facility for purposes of the CERCLA onsite permitting exemption in accordance with CERCLA Section 104(d)(4).[1]

Following treatment, the 183-H Basin waste would meet the ERDF waste acceptance criteria (BHI 2002). Disposal at the ERDF would satisfy the dangerous waste disposal requirements under WAC 173-303 because the ERDF is designed and operated to meet the substantive requirements of a RCRA landfill, including minimum technological standards for a liner/leachate collection system. Disposal at the ERDF would also satisfy the 10 CFR 61 requirements because the ERDF is authorized to receive LLW that meets the ERDF waste acceptance criteria. The requirements of the ERDF delisting petition would be met for all of the 183-H Basin waste streams.

5.2.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. This alternative would substantially reduce both the toxicity and mobility of contaminants in the 183-H Basin waste. The proposed treatment process would eliminate the characteristic of ignitability and would reduce the mobility of metals occurring as UHCs. There would be some increase in volume due to the addition of treatment agents, but the reduction in toxicity and mobility would be significantly more valuable in protecting human health and the environment.

5.2.3 No Treatment/ERDF Disposal

This alternative would not be effective at protecting human health and the environment and would not satisfy all ARARs. There would be insufficient justification for a treatability variance under RCRA for the D001 waste code, and approval of a waiver under CERCLA would be unlikely.

5.2.3.1 Long-Term Protectiveness. This alternative would not be protective in the long term because it would involve placing the untreated 183-H Basin waste in the ERDF for final disposal. Some of the waste (approximately half by volume) exhibits the characteristic of ignitability, which could enhance the combustion of other materials in the ERDF with resulting risks to workers and releases to the environment.

5.2.3.2 Short-Term Protectiveness. This alternative would be protective in the short term. There would be some risk to workers during the process of transporting the waste to ERDF and placing it there, but this risk would be mitigated through appropriate controls and would be lower than the risk associated with the treatment alternative. Because the waste containers would not be opened, there would be minimal risk of releasing the waste into the environment during transportation to or placement in the ERDF.

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[1] CERCLA Section 104(d)(4) states that where two or more noncontiguous facilities are reasonably related on the basis of geography, or on the basis of threat or potential threat to the public health or welfare or the environment, the President may, at his discretion, treat these facilities as one for the purposes of this section. The preamble to the National Contingency Plan indicates that when noncontiguous facilities are reasonably close to one another and wastes at those sites are compatible for a selected treatment or disposal approach, CERCLA Section 104(d)(4) allows the lead agency to treat these related facilities as one site for response purposes and, therefore, allows waste transfer between such noncontiguous facilities without having to obtain a permit.

5.2.3.3 Compliance with ARARs. This alternative would not meet ARARs for disposal at the ERDF. Chemical reduction is technically appropriate for addressing inorganic waste carrying the D001 ignitable waste code, so a treatability variance under RCRA would not be justified. Because it is technically feasible to perform treatment, treatment is necessary to address a known risk, and treatment does not present an undue risk to the environment, it would not be reasonable to seek a CERCLA waiver for the ignitable waste.

5.2.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment. This alternative would not involve any treatment.

5.3 IMPLEMENTABILITY

5.3.1 No Action

This alternative would be implementable in the short term but would become increasingly difficult to maintain in the long term. The 183-H Basin waste currently accounts for approximately half of the mixed LLW stored at the CWC and could eventually limit the ability of the CWC to receive other Hanford Site waste.

5.3.2 Treatment/ERDF Disposal

This alternative would be implementable, assuming approval of the treatability variance approach for LDR compliance proposed for the 183-H Basin waste. The treatment process would be similar to the process already being used for other Hanford Site remediation wastes. It would employ technologies that have been widely used in many industries and whose effectiveness is well established. The treatability variance approach proposed for formic acid and vanadium pentoxide is reasonable given the very low concentrations of these contaminants in the waste streams.

5.3.3 No Treatment/ERDF Disposal

This alternative likely would not be implementable. Without treatment, the waste could potentially ignite combustible material disposed at the ERDF, increasing the risk that either the 183-H Basin waste or other waste disposed at the ERDF would be released to the environment. In addition, it would not satisfy LDR standards.

5.4 COST

5.4.1 No Action

The cost of the No Action alternative (continued long-term storage at the CWC) would be some incremental cost of continued storage of this waste at the CWC.

5.4.2 Treatment/ERDF Disposal

The total cost of the Treatment/ERDF Disposal alternative would be approximately $3.7 million. This includes the following:

- Container preparation and shipment to ERDF: $1,900,000. The estimate is based on averaging one shipment per working day using two trailers and one tractor (FH 2002).
- Treatment of waste designated D001: $1,604,000. Assumptions for this estimate are provided in Appendix C.
- Disposal at ERDF: $161,000. The estimate is based on a total waste tonnage of 4,900 and an ERDF disposal cost of $32.85 per ton of waste (Feaster 2002).

5.4.3 No Treatment/ERDF Disposal

The total cost of the No Treatment/ERDF Disposal alternative would be $2.1 million. This includes the following:

- Container preparation and shipment to ERDF: $1,900,000. The estimate is based on averaging one shipment per working day using two trailers and one tractor (FH 2002).
- Disposal at ERDF: $161,000. The estimate is based on a total waste tonnage of 4,900 and an ERDF disposal cost of $32.85 per ton of waste (Feaster 2002).

6.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Based on effectiveness, implementability, and cost, the preferred alternative is Treatment/ERDF Disposal. This alternative is the only alternative that would meet all ARARs and be very effective in the long term at protecting human health and the environment. The No Treatment/ERDF Disposal alternative would cost somewhat less, but would not meet ARARs or be effective in the long term at protecting human health and the environment.

7.0 REFERENCES

10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," *Code of Federal Regulations*, as amended.

40 CFR 61, "National Emissions Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

40 CFR 260, "Hazardous Waste Management System: General," *Code of Federal Regulations*, as amended.

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 262, "Standards Applicable to Generators of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 263, "Standards Applicable to Transporters of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

40 CFR 266, "Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities," *Code of Federal Regulations*, as amended.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*, as amended.

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WAC 173-400, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended.

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APPENDIX A

BASELINE COST ESTIMATE FOR OFFSITE TREATMENT AND DISPOSAL AT THE MIXED WASTE TRENCH

APPENDIX A

BASELINE COST ESTIMATE FOR OFFSITE TREATMENT AND DISPOSAL AT THE MIXED WASTE TRENCH

This appendix provides a cost estimate for the baseline disposition path forward for the 183-H Basin waste residing in the Hanford Site's Central Waste Complex (CWC). Subject path forward includes the direct disposal of the treated waste residues (solidified liquids) and the treatment and disposal of the untreated wastes (e.g., precipitated crystals, sludges, sandblast grit, debris).

The following are key assumptions used to develop the cost estimate:

- The Hanford Site's CWC is operating and able to stage and ship out waste.
- The direct disposal activity is assumed to occur over 2 years.
- The treatment activity is assumed to occur over 3 years.
- Hanford Teamsters are used for all onsite shipments (leased conveyance equipment) and commercial transporters used for all offsite shipments (contracted service).
- No additional restrictions to waste movements are incurred at the CWC or the Mixed Waste Disposal Unit.
- Returned treated waste is unloaded into the Mixed Waste Disposal Unit via a crane.
- The volume increase due to the treatment process is assumed to be 25%.
- Nonthermal chemical reduction as part of stabilization treatment technologies is used to treat the waste.
- Contracted treatment costs are based on similar commercial mixed low-level waste treatment activities.
- Disposed waste is covered once a month.

Cost Estimate:

183-H Basin Waste Direct-Disposal Waste (MLLW-01)

Onsite Labor Costs:	$684,000
Contracted Costs:	$ 69,000
Contingency (5%):	$ 38,000
Subtotal:	$791,000

183-H Basin Waste Requiring Treatment (MLLW-02, 04A, and 04B)

Onsite Labor Costs:	$ 3,406,000
Contracted Costs:	$ 7,021,000
Contingency (5%):	$ 522,000
Subtotal:	$10,949,000

Combined Total = $11,740,000

APPENDIX B

WASTE ANALYSIS AND DESIGNATION

APPENDIX B

WASTE ANALYSIS AND DESIGNATION

Table B-1. Basin 3 Solids and Other Waste. (2 Pages)

Basin 3 Solids, Sand Blast Grit and Unknown Basin 3 or 4 In Test Report, Basin 3 Sludge, Sand Blast Grit, 183-H Miscellaneous, and Repackaged Solids on Designations.

Laboratory Analyte	Low mg/kg	High mg/kg	Designation Value (Typically 90% UCL)	Low Sample Number	High Sample Number
% Solids	58.6	99.5	N/A	B0BL49	B08N38
Chloride	<7.3	1,330	N/A	B08XC7	B08L21
Fluoride	18.8	59,500	N/A	B08ZK3	B08ZN3
Formate[a]	<1.3	493	370[b]	B08N18	B08ZM5
Cyanide	<0.25	6.58	1.62[c]	B08N44	B08Z14
Sulfate	<95.9	278,000	N/A	B08N26	B08Z14
N02/N03 as N	0.63	95,500	313,000[d]	B08N18	B08L31
Total organic carbon	231	3,690	N/A	B08L37	B0BZK3
pH	8.2	13.3	12.1	B08L21	B08XC9
Phosphate P-total	34.3	882	N/A	B08ZM8	B08XC9
Silver	<0.21	206	110	B08N38	B0BXD3
Aluminum	733	42,300	N/A	B08N36	B08ZK3
Barium	9.4	2,460	1063	B08N20	B08ZK3
Beryllium	<0.02	8	7.6	B08N20	B08ZN2
Calcium	768	90,400	N/A	B08ZN2	B08ZK3
Cadmium	<0.13	4.6	3.4	B08N26	B08ZN2
Cobalt	0.6	17.9	N/A	B08ZJ0	B08ZK3
Chromium	5.4	300	210	B08N20	B08ZH6
Copper	63.6	142,000	N/A	B08N26	B0BXD3
Iron	713	14,700	N/A	B08ZM7	B08ZK3
Mercury	<0.03	10.5	5.6	B08N18	B08L31
Potassium	<47	<1,515	N/A	B08N20	B08L49
Magnesium	74.4	12,700	N/A	B08ZN2	B08ZK3
Manganese	46.1	984	N/A	B08N26	B08ZN2
Molybdenum	<0.28	<50	N/A	B0BN38	B0BL49
Sodium	501	248,000	N/A	B08N29	B08ZJ4
Nickel	1.2	121	100	B08N21	B0BL27
Antimony	1.25	<43.4	43	B08N27	B0BL43
Selenium	<0.12	2.8	1.6	B0BZN3	B08XD1
Silicon	236	6,480	N/A	B08N28	B08ZK3
Vanadium	<0.23	123	48[e]	B0BZN3	B08ZK3

Table B-1. Basin 3 Solids and Other Waste. (2 Pages)

Basin 3 Solids, Sand Blast Grit and Unknown Basin 3 or 4 In Test Report, Basin 3 Sludge, Sand Blast Grit, 183-H Miscellaneous, and Repackaged Solids on Designations.

Laboratory Analyte	Low mg/kg	High mg/kg	Designation Value (Typically 90% UCL)	Low Sample Number	High Sample Number
Zinc	12.3	699	N/A	B0BN28	B0BZM8
Zirconium	32.5	38,300	N/A	B0BZK3	B08ZM8
Selenium 79 (pCi/g)	0.71	<1.5	N/A	B0BZH5	B0BZM5
Iodine 129 (pCi/g)	<0.049	<0.15	N/A	B0BZM5	B0BZH5
Neptunium 237 (pCi/g)	0.11	0.12	N/A	B0BZM5	B0BZH5
Technetium 99 (pCi/g)	2.9	1,500	N/A	B0BN30	B08L16
Total uranium (μg/kg)	3.1	5,300	N/A	B08N39	B08L32
Arsenic – TCLP (μg/L)	<10.8	<66	N/A	B0BN18	B0BL43
Barium – TCLP (μg/L)	102	993	N/A	B0BL31	B0BN31
Cadmium – TCLP (μg/L)	<1.3	36.9	N/A	B0BL31	B0BN20
Chromium – TCLP (μg/L)	5.3	1,280	N/A	B0BN30	B0BN40
Lead – TCLP (μg/L)	<10.3	2,090	N/A	B0BN18	B0BN36
Mercury – TCLP (μg/L)	<0.05	13	N/A	B0BN18	B0BL31
Selenium – TCLP (μg/L)	<25.55	<314	N/A	B0BN44	B0BL31
Silver – TCLP (μg/L)	<2.05	1,610	N/A	B0BN18	B0BL43

[a]Formate is the analytical constituent of formic acid that can be measured.
[b]Value is expressed as formic acid converted from formate based on molecular weights.
[c]Value is the total of all Cn compounds reported on designation.
[d]Value is expressed as sodium nitrate converted from nitrogen based on molecular weights.
[e]Value is expressed as vanadium pentoxide converted from vanadium based on molecular weights.
< = Indicates a less than detection limit value is reported, a value of one-half the detection limit is presented.
N/A = not applicable
TCLP = toxicity characteristic leaching procedure
UCL = upper confidence limit

Table B-2. Liquid Materials that Have Been Stabilized. (2 Pages)

Solidified Seepage Liquid and Solidified Evaporated Liquid on Both Test Report and Designations.

Laboratory Analyte	Low mg/kg	High mg/kg	Designation Value (Typically 90% UCL)	Low Sample Number	High Sample Number
% Solids	51.3	83.4	N/A	B0C6K0	B0C8B8
Chloride	396	1,520	N/A	B086J2	B08Z42
Fluoride	23.1	568	N/A	B0C8L3	B08Z42
Formate[a]	7.86	441	220[b]	B09TL5	B0C6J4
Cyanide	<0.31	2.3	1.09[c]	B088J0	B0BZ16
Sulfate	1,190	17,000	N/A	B0C8K2	B08Z42
N02/N03 as N	3,750	39,100	29,000[d]	B0C8L6	B108Z30
Total organic carbon	1,030	27,600	N/A	B08Z18	B0L6K2
pH	12.8	13.3	13.2	B08L6K2	B08Z20
Phosphate P-total	11.9	171	N/A	B0BZ50	B0C8L7
Silver	<0.03	1.4	0.31	B0C8G0	B0C8K0
Aluminum	4,790	8,610	N/A	B0C8H2	B0B6J0
Barium	9.1	23.9	19	B0C8H2	B0C8M6
Beryllium	<0.02	0.37	0.33	B08Z30	B0C8M6
Calcium	91,600	187,000	N/A	B0C6H2	B0C6M6
Cadmium	<0.27	<0.43	0.28	B0C8J6	B0C8K0
Cobalt	<0.7	3.7	N/A	B0C8J4	B0C8J0
Chromium	18	75.8	40	B0C8L4	B08Z42
Copper	7	45.7	N/A	B0C8L6	B08Z42
Iron	2,220	4,600	N/A	B0C8H2	B0C8L6
Mercury	<0.03	<0.08	0.03	B08Z16	B08Z42
Potassium	1,110	2,370	N/A	B0C8H2	B08Z42
Magnesium	11,500	22,000	N/A	B0C8H2	B088J0
Manganese	36	73.1	N/A	B0C8H2	B088J0
Molybdenum	<2.3	7.4	N/A	B08Z46	B0C6K6
Sodium	38,400	87,600	N/A	B0C8H2	B08Z18
Nickel	8.7	35.1	17	B0C8H2	B08Z42
Antimony	<1.65	6	3.6	B08Z20	B08Z42
Selenium	<0.12	3.5	3.1	B0C8L0	B08Z16
Silicon	576	18,600	N/A	B0C8J4	B08Z16
Vanadium	3.6	8.1	8.7[e]	B08Z56	B0B6J0
Zinc	5.8	19.2	N/A	B0C8G8	B0C6M6
Zirconium	2.05	43.8	N/A	B0C8G0	B08Z56
Selenium 79 (pCi/g)	0.058	<1.5	N/A	B0C8J4	B0C6L1
Iodine 129(pCi/g)	<0.02	450	N/A	B0C8H9	B08Z57
Neptunium 237(pCi/g)	0.002	0.034	N/A	B0C8H9	B08Z41

Table B-2. Liquid Materials that Have Been Stabilized. (2 Pages)

Solidified Seepage Liquid and Solidified Evaporated Liquid on Both Test Report and Designations.

Laboratory Analyte	Low mg/kg	High mg/kg	Designation Value (Typically 90% UCL)	Low Sample Number	High Sample Number
Technetium 99 (pCi/g)	1,600	12,000	N/A	B0C8K1	B08Z43
Total uranium (μg/kg)	85	750	N/A	B0C8L5	B0BZ43
Arsenic – TCLP (μg/L)	<13.35	95.5	N/A	B0BZ26	B0BZ42
Barium – TCLP (μg/L)	97.7	396	N/A	B0BZ56	B0BZ24
Cadmium – TCLP (μg/L)	<2.2	5	N/A	B0BZ16	B0BZ20
Chromium – TCLP (μg/L)	157	1,640	N/A	B0C6G8	B0BZ48
Lead – TCLP (μg/L)	<9.5	34.7	N/A	B0BZ16	B0C6J8
Mercury – TCLP (μg/L)	<0.04	0.83	N/A	B0BZ60	B0BZ26
Selenium – TCLP (μg/L)	<25.5	52.4	N/A	B0BZ16	B0B6J0
Silver – TCLP (μg/L)	<2.3	<2.3	N/A	B0BZ16	B0BZ16

[a]Formate is the analytical constituent of formic acid that can be measured.
[b]Value is expressed as formic acid converted from formate based on molecular weights.
[c]Value is the total of all Cn compounds reported on designation.
[d]Value is expressed as sodium nitrate converted from nitrogen based on molecular weights.
[e]Value is expressed as vanadium pentoxide converted from vanadium based on molecular weights.
< = Indicates a less than detection limit value is reported, a value of one-half the detection limit is presented.
N/A = not applicable
TCLP = toxicity characteristic leaching procedure
UCL = upper confidence limit

Table B-3. Materials Displaying the D001 Ignitability Characteristic. (2 Pages)

Precipitated Crystal and Basin 4 Solids on Test Report and Precipitated Solids and Basin 4 Sludge on Designations.

Laboratory Analyte	Low mg/kg	High mg/kg	Designation Value (Typically 90% UCL)	Low Sample Number	High Sample Number
% Solids	69.6	99.2	N/A	B08Z90	B08YR2
Chloride	<7.1	367	N/A	B08XC3	B08Z90
Fluoride	347	47,300	N/A	B0BRJ3	B08ZP7
Formate[a]	<63	1,900	710[b]	B0BRY2	B08522
Cyanide (total)	<0.25	4.7	0.65[c]	B08RJ4	B08Z90
Sulfate	6,440	313,000	N/A	B08RY2	B08ZG7
N02/N03 as N	13,700	185,000	909,000[d]	B08RJ3	B0BS04
Total organic carbon	150	7,990	N/A	B08RY6	B08ZK8
pH	9.2	13.2	11.7	B08ZP5	B0BS10
Phosphate P-total	2.8	82.5	N/A	B08RX0	B08Z87
Silver	<0.21	203	120	B08S24	B08XC3
Aluminum	17.1	1,750	N/A	B08RZ4	B09ZP9
Barium	<0.23	18	4.6	B08RY2	B08RX2
Beryllium	<0.01	5.3	4.3	B08RZ2	B08Z44
Calcium	47.9	13,700	N/A	B0BRZ4	B08S02
Cadmium	<0.13	5.9	3.1	B08S16	B08Z90
Cobalt	<0.17	<4.15	N/A	B08YR6	B08Z93
Chromium	<0.85	302	190	B08YR4	B08Z90
Copper	39.9	154,000	N/A	B08YR2	B08Z90
Iron	<16.8	2,560	N/A	B08S16	B08Z90
Mercury	<0.03	18.9	15	B08RW2	B08ZB3
Potassium	27.8	2,190	N/A	B08S06	B08ZK8
Magnesium	<1.67	1,710	N/A	B08ZG8	B08S02
Manganese	<0.65	1,050	N/A	B0BS24	B08Z90
Molybdenum	0.47	36.1	N/A	B08S14	B08Z90
Sodium	142,000	344,000	N/A	B08ZG7	B08RW6
Nickel	<0.4	132	81	B08RY4	B08Z90
Antimony	<1.26	27.1	25.4	B08S16	B08ZB3
Selenium	<0.04	0.89	0.6	B08S24	B08ZB3
Silicon	64.4	5,150	N/A	B08S16	B08Z44
Vanadium	<0.18	12.8	1.7[e]	B08S24	B08Z93
Zinc	<0.21	456	N/A	B08RY2	B08Z90
Zirconium	14.3	41,900	N/A	B0BRY2	B08Z90
Selenium 79 (pCi/g)	<0.061	<2.6	N/A	B08Z90	B08Z44
Iodine 129 (pCi/g)	<0.002	<0.4	N/A	B08Z44	B08Z90
Neptunium 237 (pCi/g)	0.007	0.09	N/A	B08RZ3	B08Z90

Table B-3. Materials Displaying the D001 Ignitability Characteristic. (2 Pages)

Precipitated Crystal and Basin 4 Solids on Test Report and Precipitated Solids and Basin 4 Sludge on Designations.

Laboratory Analyte	Low mg/kg	High mg/kg	Designation Value (Typically 90% UCL)	Low Sample Number	High Sample Number
Technetium 99 (pCi/g)	18	2,800	N/A	B08S07	B08Z88
Total uranium (μg/kg)	1.7	1,000	N/A	B0BS08	B08Z88
Arsenic – TCLP (μg/L)	<13.25	72.7	N/A	B0BRJ3	B0BRY6
Barium – TCLP (μg/L)	56	846	N/A	B0BS16	B0BRJ4
Cadmium – TCLP (μg/L)	<1.3	9.4	N/A	B0BS16	B0BS12
Chromium – TCLP (μg/L)	46.7	202	N/A	B0BRY4	B0BRJ1
Lead – TCLP (μg/L)	<10.3	57.6	N/A	B0BS14	B0BRX8
Mercury – TCLP (μg/L)	0.25	2.4	N/A	B0BS10	B0BS24
Selenium – TCLP (μg/L)	<25.55	<63	N/A	B0BRW2	B0BRW8
Silver – TCLP (μg/L)	<2.85	14.6	N/A	B0BRW8	B0BRZ3

[a]Formate is the analytical constituent of formic acid that can be measured.
[b]Value is expressed as formic acid converted from formate based on molecular weights.
[c]Value is the total of all Cn compounds reported on designation.
[d]Value is expressed as sodium nitrate converted from nitrogen based on molecular weights.
[e]Value is expressed as vanadium pentoxide converted from vanadium based on molecular weights.
< = Indicates a less than detection limit value is reported, a value of one-half the detection limit is presented.
N/A = not applicable
TCLP = toxicity characteristic leaching procedure
UCL = upper confidence limit

APPENDIX C

COST ESTIMATE FOR WASTE TREATMENT AT THE ERDF

APPENDIX C

COST ESTIMATE FOR WASTE TREATMENT AT THE ERDF

This appendix provides a rough order of magnitude (+50%, -30%) cost estimate for treating 183-H Basin mixed waste at the Environmental Restoration Disposal Facility (ERDF). This cost estimate does not include the cost to prepare the waste containers for shipment, transport the containers to the ERDF, or to dispose of the treated waste in the ERDF.

Key assumptions used in developing the estimate are as follows:

- Total number of drums is 5,741.
- Each drum weighs 363 kg (800 lb).
- All drums are overpacked.
- Overpack containers do not exceed a 322-L (85-gal) capacity.
- No other waste is treated at the ERDF during the 183-H Basin waste campaign.
- Drum opening does not require additional inspections or elicit industrial hygiene concerns.
- 50 drums are treated per workday (200 per week).
- Waste shipments support the 50-drum-per-day production rate (standby rates for rented equipment and cement that would be incurred if this rate is not supported are not included).
- Waste will be treated in 50-drum batches.
- A backhoe would be used to mix waste with treatment agents and water.
- One full day will be required to remove inner drums from overpacks, dump the contents into treatment box, and add and mix cement and water.
- The remaining drums for direct disposal will require additional handling should free liquids be present.

The estimate for all labor, material, and equipment is $1,244,432.00 or $542.00 per ton (2,083 total metric tons [2,296 total tons] for treatment). The overhead rate is 29.04%, which increases the total estimate to $1,604,202.00.

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